

Animated Video on Thermochemistry Materials with Everyday Life Phenomena to Increase High School Student's Understanding

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Abstract. The low innovation of learning media used in online learning causes the learning process not to take place optimally. This incident gave rise to the phenomenon of learning loss. This study aims to develop and assess the quality of animated videos that contain everyday life phenomena on thermochemistry material to increase students' understanding of online learning. The method used in this research is research and development with a 4D model (define, design, development, and dissemination). This research used a purposive sampling technique limited to chemistry teachers and high school students in grades XI and XII. The product was validated by material experts, media experts, and four reviewers and was responded to by ten students. The instruments used were validation sheets, product quality assessment sheets, and student responses. The results of the evaluation of the quality of animated videos by material experts were 91.4% with very good criteria, media experts 90% with very good criteria, and reviewers 90.9% with very good criteria. Ten high school class XI students responded positively, with a percentage of 93%. So, it can be concluded that the product developed is suitable for use as an alternative medium in online learning of thermochemical material to increase student understanding.

Keywords: Animated videos; thermochemistry; everyday life phenomena; understanding; online learning

Introduction

The covid-19 pandemic caused by the coronavirus impacts various aspects of human life (Herliandry et al., 2020). Deaths, disruption of educational activities, and behavioral or psychological changes experienced by people are examples of the real impacts that have occurred as a result of this pandemic (Agung, 2020). These various impacts have led to the implementing of policies limiting social interactions on a large scale to minimize the spread of this virus (Abidah et al., 2020). The existence of restrictions on social interaction causes many schools to close, and the learning process is carried out online (Sun et al., 2020). The Circular Letter Number 4 of 2020 was conveyed by the Minister of Education regarding the education policy during the emergency period for the spread of the coronavirus, called online learning. Online learning is an educational process carried out when teachers and students are in different places through media that can connect the two and create learning interactions

(Prawiyogi et al., 2020). Therefore, technology is needed to facilitate students and teachers during online learning (Yusuf, 2020). Online learning requires high student awareness (Yuangga & Sunarsi, 2020). However, the transition from offline to online classes causes a decrease in competency mastery and student learning outcomes (Astuti & Prestiadi, 2020).

Implementing online classes causes the learning process not to run optimally (Annisah & Masfiah, 2021). As a result, learning loss occurs during online classes (Donnelly & Patrinos, 2022; Engzell et al., 2021; Kaffenberger, 2021). Learning loss is a phenomenon that occurs due to a need for more facilities and teacher quality in utilizing technology during online classes (Hazin et al., 2021). Learning loss causes students difficulties understanding and mastering knowledge, skills, and attitude competencies during the educational process (Assiddiqi & Soeryanto, 2021). This learning loss phenomenon is characterized by decreased achievement, interest in learning, and increased student saturation during the educational process (Huang et al., 2020; Zhao, 2022). This phenomenon can also be caused by the ineffectiveness of the learning methods used so that students cannot understand the material delivered by the teacher (Zaitun et al., 2021).

The lack of learning media is also one of the factors causing the learning loss phenomenon (Abdurrahmansyah et al., 2022). Learning media is needed to increase the effectiveness and efficiency of the educational process (Bali & Musrifah, 2020). Learning media contributes to achieving academic purposes (Telaumbanua, 2022). The benefits of learning media include (1) increasing student learning motivation, (2) stimulating students to be able to remember and understand the material being studied, (3) making students more active in providing responses or feedback, and (4) motivating students to apply what is learned in everyday life (Baharun et al., 2019). However, using learning media in the online class has been considered less than optimal (Sadeghi, 2019). Therefore, innovation is needed to develop interactive, practical, and exciting learning media (Bali et al., 2021). One of the innovations that can be done is to develop an animated video (Abrori, 2022). Animated videos contain elements of text, images, animation, audio, and graphics (Rulismi et al., 2022). Animated videos can create a fun learning atmosphere, increase motivation, and train student discipline and independence (Putra & Kartini, 2020). Even abstract material can be easily understood by students if it is explained using animated videos (Abbas et al., 2020). However, existing programs for creating animated videos are generally complex to use because they require high design skills, and the software is paid (Firdaus et al., 2021; Sidabutar & Reffina, 2022).

One free and easy-to-use video animation program is the Powtoon web app (Rahmawati et al., 2021; Wu et al., 2018). Powtoon is a web-based application accessed online through various internet-connected devices (Fardany & Dewi, 2020). Powtoon can present text, images, audio, animation, graphics, and video with easy controls (Ananda & Zulfadewina, 2023). Powtoon can make animated videos quickly and easily by inserting images, sounds, and music and manipulating a still object to move (Razi, 2021). Powtoons can also increase students' motivation, interest in learning, and understanding (Fatmawati, 2021; Sukmanasa et al., 2020). Powtoon can improve teachers' skills in managing online learning (Qurrotaini et al., 2020). Powtoon can also visualize objects to be more natural (Tiwow et al., 2022). Therefore, students' understanding of abstract material increases when explained using Powtoon (Lestari et al., 2022; Tafani & Kamaludin, 2023).

One field of natural science with various abstract concepts and theories is chemistry (Nurhamidah et al., 2021). Many students have difficulty understanding chemistry because of the complex material (Nainggolan & Mutiah, 2020). One of the most complex

chemistry to study is thermochemistry (Saraswati et al., 2019). Thermochemistry material requires students to simultaneously understand abstract chemical concepts, principles, and theories (Triana et al., 2021). The thermochemical material itself studies the law of conservation of energy, systems, and the environment, types of reactions in thermochemistry, standard enthalpy changes, thermochemical equations, and calculating the enthalpy change of a reaction (Sutiani & Fayaddah, 2021). The many examples of phenomena in everyday life related to thermochemical material can increase the significance of learning chemistry (Marlina, 2020; Muthi'ah, 2022). However, only a few teachers have linked thermochemical material to the phenomena of everyday life (Sihaloho et al., 2021). These conditions make students quickly bored and uninterested in studying thermochemical material (Wildayani et al., 2021). As a result, students' understanding of thermochemical material is less than optimal, and student learning outcomes could be better (Lusi et al., 2023). Presentation of less attractive material and the conventional methods used by teachers is also one of the factors that cause a decrease in students' understanding levels (Donasari & Silaban, 2021).

One solution to increase student understanding is animated videos based on everyday life phenomena (Nofitri, 2017). Learning by linking everyday life phenomena can encourage students to implement the material they have learned in everyday life (Inayah, 2023). Learning based on everyday life phenomena can also increase activity and motivate students to study chemistry (Jannah, 2017). The learning process can improve students' understanding and learning outcomes (Seran, 2023). In addition, teaching materials that are oriented to everyday life phenomena can increase interest, understanding, and learning independently (Insirawati, 2018).

Based on the description of the problems above, this study aims to develop an animated video containing everyday life phenomena on thermochemical material using the Powtoon web app to increase students' understanding of online learning. This animated video will increase the rate of students' understanding in studying thermochemistry material through real examples. In addition, it makes it easier for teachers to explain thermochemical material associated with everyday life phenomena.

Methods

This research conducted using the research and development (R & D) method with the 4D development model, which includes defining, designing, developing, and disseminating, as seen in Figure 1.



Figure 1. 4D development model

The purpose of the define stage is to determine the requirements needed in developing the product. This stage includes analysis of needs, students, concepts, and assignments. Needs analysis aims to determine the type of learning media used, material characteristics, types of student learning, and difficulties experienced by teachers during online learning. Interviews with chemistry teachers and high school students in Yogyakarta is a data collection technique used to analyze needs. Furthermore, students were analyzed to determine learning attitudes and difficulties experienced by students during the

online learning process, including learning materials that were considered problematic. Based on the results of the analysis of the two processes, the material that will be developed in learning media is determined through concept analysis. Then determine the learning indicators and material components and formulate learning objectives that must be mastered by students to achieve minimum competence as part of the task analysis.

The design stage begins with the selection of instructional media and applications used to meet the analysis results criteria at the define stage. Then the process of designing the flow of material and content of learning media is carried out which is called the format selection process. Next, the collection of material references is carried out. The last step is preparing the initial design of the product to be developed and designing research instruments.

The development stage aims to produce a quality and fulfilling product based on the assessment results. The assessment process used a product quality assessment questionnaire filled in by one material expert, one media expert, and four chemistry teachers as reviewers with a Likert scale. After obtaining the score, the overall average value and each aspect of the questionnaire is calculated by adding up the scores of each assessor and dividing by the number of assessors. Then, the average value is converted into qualitative data based on ideal assessment criteria, as in Table 1 (Amran et al., 2023).

Table 1. Ideal assessment criteria

No	Score Range	Criteria
1.	$Xi + 1.80 S_{Bi} < \bar{X}$	Very good
2.	$Xi + 0.60 S_{Bi} < \bar{X} \leq Xi + 1.80 S_{Bi}$	Good
3.	$Xi - 0.60 S_{Bi} < \bar{X} \leq Xi + 0.60 S_{Bi}$	Pretty good
4.	$Xi - 1.80 S_{Bi} < \bar{X} \leq Xi - 0.60 S_{Bi}$	Not enough
5.	$\bar{X} \leq Xi - 1.80 S_{Bi}$	Very less

The products assessed are then responded to by ten grade XI high school students using the Guttman scale, which consists of positive and negative statements. Then, the data is converted into quantitative data using the Guttman scale. The data converted into a score is then calculated by dividing the average score by the ideal maximum score and multiplying it by 100%. Then, the data obtained is interpreted to be qualitative data with the criteria as in Table 2 (Astuti & Kamaludin, 2023).

Table 2. Data interpretation

No.	Ideal percentage	Criteria
1.	0 – 20	Very less
2.	21 – 40	Not enough
3.	41 – 60	Pretty good
4.	61 – 80	Good
5.	81 – 100	Very good

The dissemination stage is the product dissemination stage, which includes packaging, diffusion, and adoption. The packaging process is carried out to make the product easier to use and can be used widely so that the product is uploaded to the Youtube platform. At the same time, the diffusion and adoption process is carried out by disseminating the final product to chemistry teachers and high school students.

Results and Discussion

The development of Powtoon animation video learning media on thermochemical material with everyday life phenomena is carried out by adapting the 4D model where the process description is as follows.

Define

The purpose of the define stage is to find out the needs of the product being developed. The define stage includes analysis of needs, students, concepts, and assignments. Needs and student analysis was conducted through interviews with chemistry teachers and students at SMA N 8 Yogyakarta, SMA Muhammadiyah 2 Yogyakarta, and SMA Muhammadiyah 3 Yogyakarta. Based on the interview results, information was obtained that the learning method used by the teacher was still a lecture model, presentations using PowerPoint, and assignments from textbooks. The results of the interviews also informed that the teacher explained the material using PowerPoint and did not associate the learning material with everyday life phenomena. As a result, during the learning process, students tend to feel bored, causing a decrease in understanding (Irfana et al., 2022). One of the materials considered difficult during online learning in class XI is thermochemistry.

Concept analysis was conducted to determine the material's content in the learning media. This analysis focused on essential concepts in the thermochemical material that will be taught to students. Then determine the learning content that will be used in the media. Based on the analysis, the content of everyday life phenomena is chosen because it can increase the rate of students' understanding when learning. Then a task analysis is carried out to determine learning indicators and material components and formulate learning objectives that students must master to achieve minimum competencies based on the 2013 curriculum.

Design

The design stage is carried out by making a prototype of learning media. The first step is to determine the type of media to be used in online learning. The media used to increase student understanding is animated videos. Animated videos contain pictures and sounds that can stimulate students to quickly remember the material presented so as to increase student understanding (Pranata et al., 2022; Widhayanti & Abduh, 2021). Animated videos are made using the Powtoon web app because it has various exciting features with easy controls (Garsinia et al., 2020). Next, the animated video format includes the opening, content, and closing. Next, a thermochemical material script related to everyday life phenomena is compiled through textbooks, websites, and YouTube videos. After the video has been made, an assessment instrument is developed to assess its quality. The last step in the design stage is to make the initial design draft.

In this study, the initial design process was carried out using the main application in the form of the Powtoon web application, the Canva application to find supporting ornaments, Camtasia 2019 as a video editing application, Audacity as a sound editing application, and the website www.unscreen.com to remove animated backgrounds. First, determine the layout of the animation and text in Powtoon based on the material script that has been made, as shown in Figure 1.

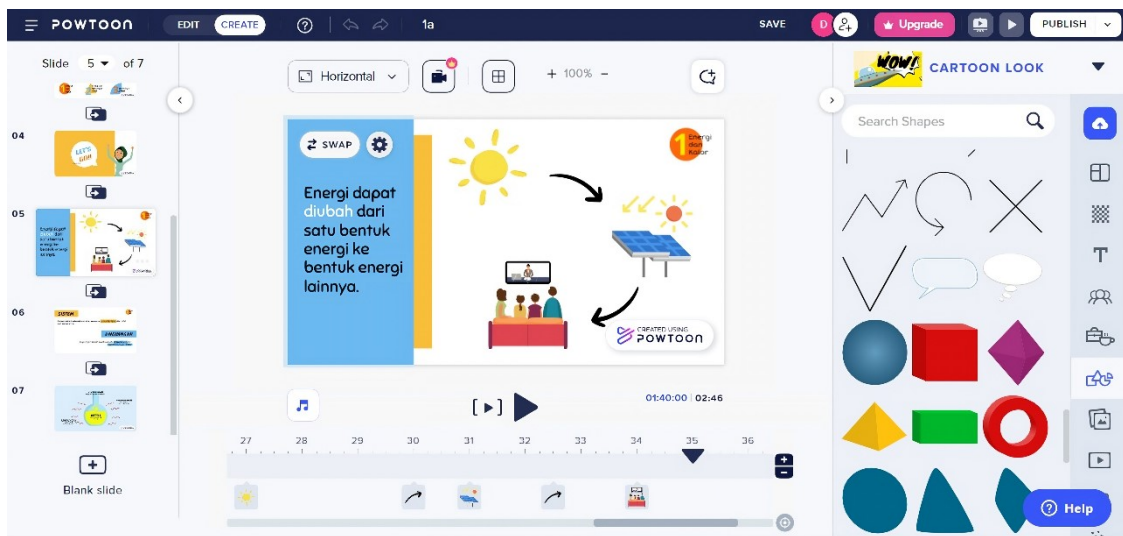


Figure 1. Making animated videos uses the Powtoon web app to determine the animation layout and text

Next, add ornaments or supporting components with the help of the Canva application, as shown in Figure 2.

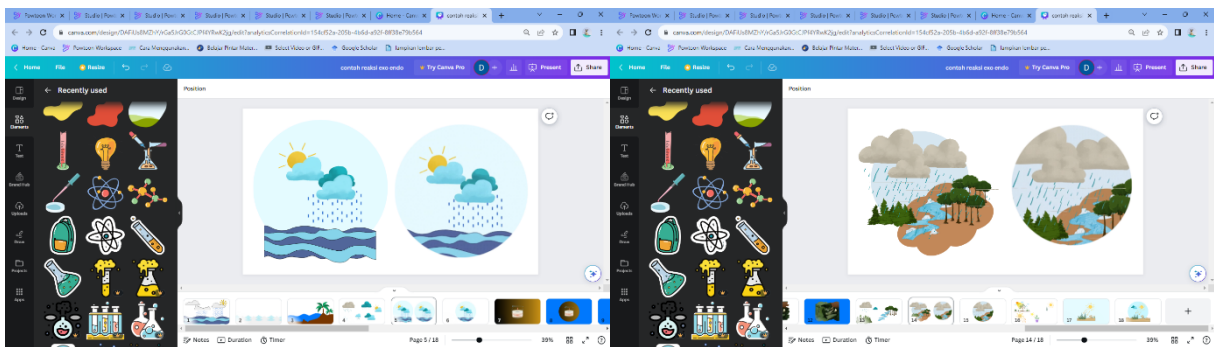


Figure 2. Editing supporting components using the Canva application to describe the material

Voice recording is done using a smartphone and edited using the Audacity application to produce a more precise sound, as shown in Figure 3.

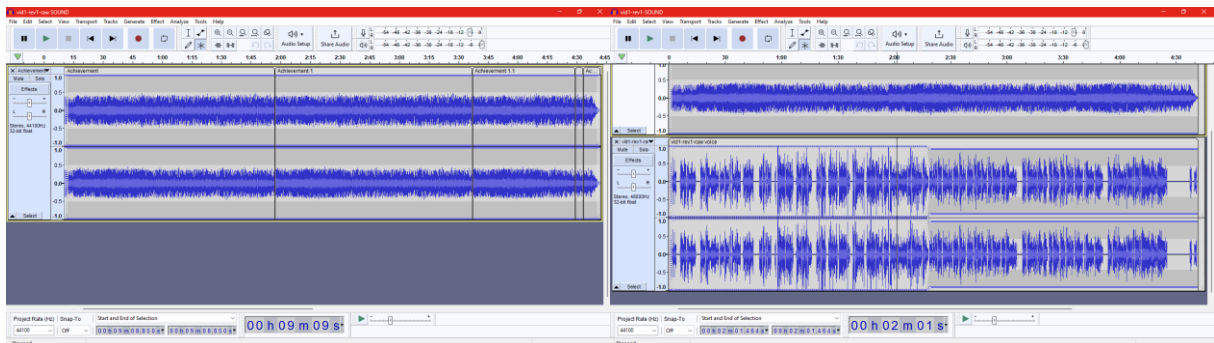


Figure 3. The sound editing process uses the Audacity application to make a clear voice

The sound editing results, which contain recorded sound, additional sound effects, and selected back sounds, are combined with Powtoon videos made using the Camtasia 2019 application, as shown in Figure 4.



Figure 4. The process of combining videos that have been made with sound editing results using the Camtasia 2019 application

In order to obtain the final product in the form of a Powtoon animation video on thermochemical material with everyday life phenomena consisting of opening, filling, and closing components with a duration of 3-8 minutes. The opening section consists of greetings, titles, and learning objectives which can be seen in Figure 5.



Figure 5. An example of the opening section of the video consists of greetings, titles, and learning objectives

The video content section is an explanation of thermochemical material consisting of 1) energy and heat covering systems (open, closed, and isolated) and the environment, 2) enthalpy and chemical equations covering the meaning of enthalpy, exothermic and endothermic reactions, and writing thermochemical equations, and 3) determination of the enthalpy change for a reaction includes the types of standard enthalpies and how to determine them. The contents of the video can be seen in Figure 6.



Figure 6. An example of video content is depicted through animation

The closing section includes conclusions, information about the following material, and acknowledgments. The appearance of the video closing section can be seen in Figure 7.

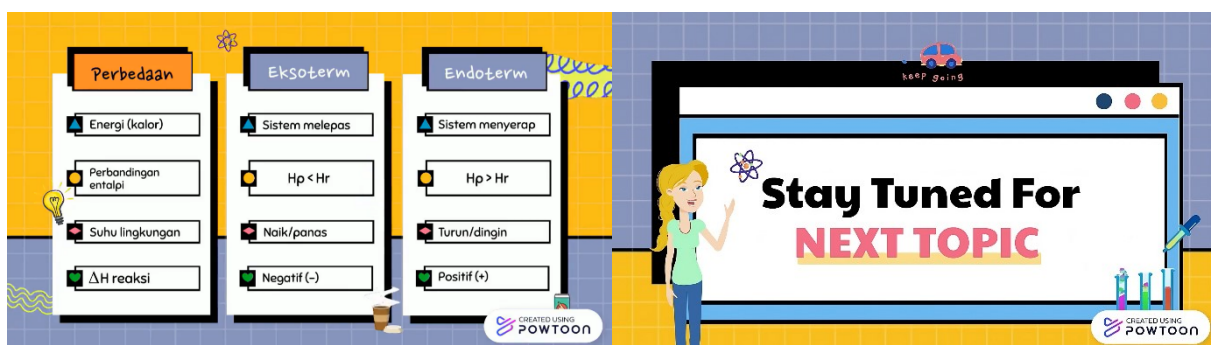


Figure 7. Several scenes of the closing part of the video consist of conclusions and information about the following material

The animated videos can improve students' understanding of abstract and complex theories or concepts (Hidayat, 2020). Animated videos have audio, illustrations, and supporting animated characters to interpret abstract concepts and theories. The illustration material in the animated video is in the form of images, videos, and animations in the form of gifs. In comparison, the supporting characters in the video are teacher characters with activities explaining, greeting, showing, and so on. The thermochemical material in 54| Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education), 12(1), p.47-63, (2024)

the animated video is explained clearly, in detail, and deeply, and related to everyday life phenomena. The content of the everyday life phenomena aims to make it easier for students to understand thermochemical material (Setianingrum et al., 2022). The phenomena in this study are natural events that students encounter in everyday life. Examples of everyday life phenomena in the animated videos include the process of burning candles, fermenting tape, condensation processes, frying food, and photosynthesis. An example of this everyday life phenomenon load can be seen in Figure 8.



Figure 8. Several scenes in the video contain everyday life phenomena

The last step in preparing this animated video is the video publication stage. The animated video created is at the high definition (HD) level with a resolution of 1334 × 750 pixels in .mp4 format so that the animated video can be seen clearly. Animated videos are then uploaded to the YouTube platform for easy access. After the animated video has been made, research instruments are created. The research instruments included validation, product quality assessment, and student responses. Product quality assessment instruments include material aspects, language, everyday life phenomena, and videos. At the same time, the student response instruments include material aspects, language, everyday life phenomena, presentation, and benefits. The instruments that have been made are then validated by the instrument experts.

Development

At the development stage, the products made are validated and assessed for quality by one material expert, one media expert, four reviewers, and ten high school students in class XI respond. The results of product quality assessment and student responses can be seen in Table 3.

Table 3. Results of product quality assessment and student responses

Assessment/ Response	Assessment Aspect	Σ Score	Σ Ideal Maximum Score	Ideal (%)	Criteria
Material experts	Material	14	15	91.4	Very good
	Language	10	10		
	Everyday Life Phenomena	8	10		
Media expert	Videos	18	20	90	Very good
Reviewer	Material	13.8	15	90.9	Very good
	Language	9.4	10		
	Everyday Life Phenomena	9	10		
	Videos	17.8	20		
Students	Material	9.5	10	93	Very good
	Language	9	10		
	Everyday Life Phenomena	9	10		
	Presentation	10	10		
	Benefit	9	10		

Based on Table 3, the results obtained from material experts, media experts, and reviewers with an ideal percentage of 91.4%, 90%, and 90.9% are in very good criteria. This result shows that the thermochemical material explained in the animated video is presented systematically and straightforwardly. The systematic and straightforward presentation of the material is shown by the suitability of the material with the KI and KD in the 2013 curriculum, has sufficient material depth, uses clear language, and the flow of delivery of the material is arranged systematically. Presentation according to these criteria can increase students' understanding of the material being studied (Azmi, 2022). In addition, the contents of everyday life phenomena included in the learning videos also make it easier for students to understand the material (Apriadi, 2021). The animated video developed also fulfills a good media concept, including clear dubbing sound, supporting sound effects, choosing contrasting colors between elements in the video, appropriate video effects, and a proportional typography layout. A proportional typography layout can help students understand the information conveyed through animated videos because typography significantly affects the readability of information (Shao et al., 2022). In addition, choosing a contrasting color between text, images, videos, and backgrounds affects the level of student attention and video quality (Anggraeni & Surya, 2021). Therefore, based on the assessment results, the thermochemical animation video developed is suitable for use as an alternative medium in the learning process to increase student understanding. Furthermore, students of class XI SMA Muhammadiyah 2 Yogyakarta, SMA Muhammadiyah 3 Yogyakarta, SMA N 8 Yogyakarta, SMA N 10 Yogyakarta, SMA Muhammadiyah Wonosobo, dan MA eL-BAS responded to the animated video. Based on the results of student responses in Table 3, the percentage of product ideality was 93%, with very good criteria. The results of student responses inform that the animated video developed can increase students' understanding because it is associated with everyday life phenomena. This statement is to the research of Rhaudah et al. (2019), which states that the learning process associated with everyday life phenomena can increase students' understanding.

Disseminate

The aim of the dissemination stage is so that the general public can directly experience the benefits of the developed product. The dissemination stage includes three main stages: validation testing, packaging, diffusion, and adoption (Mulyati et al., 2022). At the validation testing stage, the product in the form of an animated video is uploaded to google drive to determine the product's suitability due to needs in the field. The assessment was carried out by chemistry teachers and class XI high school students who had been interviewed previously. In line with Insani et al., (2023) research, the contents of everyday life phenomena were very helpful in increasing students' understanding, interest, and motivation to learn. Then, the product is packaged and uploaded to the YouTube platform for widespread distribution so that the animated videos that have been created can be absorbed (diffusion) by students and used (adopted) in the learning process, both in class and independently.

Conclusion

The product developed in this study is a Powtoon animation video on thermochemical material containing everyday life phenomena to increase students' understanding of the online learning process. This study uses a 4D model, which includes the definition, design, development, and dissemination stages. The video animation developed consists of 1) energy and heat, 2) enthalpy and thermochemical equations, and 3) determining the enthalpy change for a reaction. Video components include opening, content, and closing. The results of the product quality assessment from material experts were 91.4% with very good criteria, media experts were 90% with very good criteria, and reviewers were 90.9% with very good criteria. Class XI high school students responded positively to the product being developed with a percentage of 93%. So it can be concluded that the Powtoon animation video for the thermochemical material developed has outstanding quality. It is suitable as an alternative medium during online learning to increase student understanding.

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